

Redescription of *Bolbella californica* Allgen, 1951 (Enchelidiidae: Nematoda), with Notes on its Ecology off Southern California

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ABSTRACT: *Bolbella californica* Allgen, 1951 (Enchelidiidae: Nematoda), the southern California species of the genus, is redescribed. A limited analysis based on 79 specimens is made of its intraspecific variation. As redescribed, *B. californica* may be distinguished from all other species of this genus by the number of esophageal bulbi, 9 to 10; no previously described species has more than 8 bulbi.

B. californica was collected from 18 locations on the southern California mainland shelf, in the depth range of 5.5 to 9.1 m. Bottom sediments at these locations were variable.

A MULTIBULBATE ESOPHAGUS is characteristic of two genera, *Bolbella* and *Polygastrophora*, of the nematode family Enchelidiidae. Although superficially similar in appearance these two genera belong to two separate and distinct subfamilies, *Bolbella* to the Eurystominae and *Polygastrophora* to the Enchelidiinae. Males of the Enchelidiinae have reduced buccal cavities while those of Eurystominae are well developed, the females being well developed in both genera (Wieser, 1953).

To date 14 species have been assigned to the genus *Bolbella*. Nine of these, including 1 from California, have been synonymized with species of *Polygastrophora*, transferred to the genus *Polygastrophora*, or placed in synonymy with other species of *Bolbella*. The species *B. californica* Allgen, 1951 has been referred to *Bolbella sundaensis* Micoletzky and Kreis, 1930. Wieser (1953:133) states "I have no doubt that *B. californica* Allgen, 1951f is identical with *B. sundaensis*, though this assumption has been based on the incomplete figures and description given by the author." It is difficult to evaluate this conclusion on the evidence presented in the original description of *B. californica*.

Of *Bolbella*, 79 specimens have been collected off southern California during a benthic sam-

pling program of the Allan Hancock Foundation using the R/V "Velero IV." Based on these collections a redescription of *B. californica* Allgen is presented. In addition some notes are given regarding its ecology on the southern California mainland shelf.

GENUS *Bolbella* Cobb, 1920

TYPE: *Bolbella tenuidens* Cobb, 1920

Bolbella californica Allgen, 1951, Figures 1a-j.

COLLECTIONS: Redescriptions of the male and female are based upon a representative specimen of each collected at "Velero IV" Station 6373-59, off Huntington Beach, California, 33° 39' 25" N, 119° 01' 00" W, in 9.3 m of water. The bottom was fine gray sand with some rocks and shells. Specimens were also collected at 17 other stations on the southern California mainland shelf; these results are summarized in Table 1.

REDESCRIPTION OF THE MALE (Fig. 1a-f): Length = 2.72 mm; ratios, a = 31.6, b = 4.1, c = 16.0. Head (Fig. 1b): labial papillae six, more distinct than in female; cephalic setae 10, length to 12 μ ; buccal cavity well developed, 13 μ \times 12 μ , and separated into two chambers by two chitinous bands, anterior chamber 5 μ \times 7 μ , posterior chamber 7 μ \times 6 μ ; armature of three teeth, large right subventral tooth more slender than in female, length 7 μ , equipped with accessory piece at tip and surrounding tip; two

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FIG. 1. *Bolbella californica* Allgen, 1951. *a*, Male, entire; *b*, male, head; *c*, male, multibulbate esophagus with nine distinct bulbi; *d*, male, precloacal supplement; *e*, male, spicules and gubernaculum; *f*, male, tail; *g*, female, head; *h*, female, vulva; *i*, female, multibulbate esophagus with ten distinct bulbi; *j*, female, tail.

TABLE 1
STATION DATA

STATION	DATE	N LAT.	W LONG.	GENERAL LOCATION	DEPTH (m)	SEDIMENT	♀ ♀	♂ ♂	JUV.
6301-59	25 June 1959	34-24-42	119-40-54	Santa Barbara	5.5	br f sty sd*	2	-	-
6365-59	31 Aug. 1959	33-42-10	118-04-30	Sunset Beach	9.1	gr-blk f sd	1	-	-
6368-59	31 Aug. 1959	33-40-45	118-02-45	Sunset Beach	7.6	gr-blk m sd	1	-	-
6373-59	31 Aug. 1959	33-39-25	118-01-00	Huntington Beach	9.3	f gr sd, sh	1	1	-
6390-59	1 Sept. 1959	33-20-48	117-31-35	San Onofre	7.3	f gr sd	3	-	-
6394-59	1 Sept. 1959	33-19-15	117-30-00	Las Pulgas	7.0	f gr sd	1	-	1
6395-59	1 Sept. 1959	33-19-12	117-30-05	Las Pulgas	7.3	f gr sd	1	-	1
6398-59	1 Sept. 1959	33-13-40	117-25-05	Santa Margarita	8.8	f gr sd	1	-	-
6399-59	1 Sept. 1959	33-13-30	117-25-15	Santa Margarita	9.4	f gr sd	2	-	-
6410-59	3 Sept. 1959	32-38-10	117-08-32	San Diego	6.7	m gr sd, sh	1	-	-
6702-59	3 Dec. 1959	34-24-58	119-35-40	Summerland	5.5	v f sd	8	-	1
6721-59	4 Dec. 1959	34-23-02	119-30-40	Carpinteria	9.1	v f sd	14	1	-
6722-59	4 Dec. 1959	34-23-05	119-30-40	Carpinteria	6.7	v f sd	12	-	6
6723-59	4 Dec. 1959	34-23-10	119-30-40	Carpinteria	7.6	v f sd	6	-	-
6731-59	6 Dec. 1959	34-17-53	119-21-05	Las Pitas Pt.	7.3	v f sty sd	7	-	2
6736-59	6 Dec. 1959	34-18-55	119-23-05	Las Pitas Pt.	6.7	m sd, tubes	2	-	-
6761-59	7 Dec. 1959	33-59-55	118-29-51	Santa Monica	6.1	f sty sd	2	-	-
6763-59	7 Dec. 1959	33-59-47	118-29-30	Santa Monica	9.1	f sty sd	1	-	-

* Abbreviations: blk = black, br = brown, f = fine, gr = gray, m = medium, sd = sand, sh = shells, sty = silty, v = very.

small teeth, one left subventral in position, one dorsal in position; amphids not observed.

Body: cuticle without striations; cervical setae more numerous and longer than in female, length to 22μ ; maximum body diameter 85μ at 1400μ from the anterior end.

Esophagus (Fig. 1c): nerve ring surrounds esophagus 291μ from the anterior end, body diameter at nerve ring 58μ ; esophagus with nine distinct bulbs, posterior end of esophagus 666μ from anterior end, corresponding body diameter 79μ .

Reproductive structures: two pre-cloacal supplements present (Fig. 1d), located 390μ and 260μ anterior to the cloaca; spicules (Fig. 1e) curved, 68μ in length; gubernaculum complex, with central element from which lateral pieces project on the outer sides of the spicules, length 21μ .

Tail (Fig. 1f): cloacal opening 2550μ from anterior end, corresponding body diameter 44μ ; tail with three subterminal setae, with caudal gland orifice; tail length 170μ .

DESCRIPTION OF THE FEMALE (Figs. 1g-j): Length = 3.22 mm, ratios, a = 33.9 , b = 4.1 , c = 17.2 , Vu = 45.6% . Head (Fig. 1g): labial papillae six, indistinct; cephalic setae 10, length to 9μ ; buccal cavity $15\mu \times 15\mu$, separated into two chambers by three chitinous bands, anterior chamber $6\mu \times 10\mu$, posterior chamber $9\mu \times 9\mu$; armature of three teeth, large right subventral tooth, length 9μ , equipped with an accessory piece at tip and surrounding it; two small teeth, one left subventral in position, one dorsal in position; amphids 4μ in diameter.

Body: cuticle without striations; cervical setae scant, length to 12μ ; vulva (Fig. 1b) situated 1480μ from anterior end, corresponding body diameter 95μ .

Esophagus (Fig. 1i): nerve ring surrounds esophagus 317μ from anterior end, corresponding body diameter 49μ ; esophagus with 10 distinct bulbs; posterior end of the esophagus 780μ from anterior end, corresponding body diameter 73μ .

Tail (Fig. 1j): anus 3033μ from anterior

end, corresponding body diameter 44μ ; tail with a single subterminal seta, with caudal gland orifice, length 187μ .

INTRASPECIFIC VARIATION: A limited number of measurements were made on 62 of the 79 available specimens of *B. californica*. Based on these measurements mean ratios and corresponding ranges of body length/body width (= a), body length/esophagus length (= b), body length/tail length (= c), and vulva position as percent of body length (= Vu) were calculated. A summary of these results appears in Table 2.

A variation exists in the number of bulbi in the esophagus of females. Either 9 or 10 are present, but some specimens with 10 bulbi possess an indistinct anterior bulbus. Each of the two males examined has 9 bulbi. Allgen describes *B. californica* as possessing 7 to 9 esophageal bulbi; his figure (figure 50) shows 8. It is probable that he failed to note the indistinct anterior bulbi.

All other species of *Bolbella* possess 8 bulbi (Inglis, 1961) or less (7 in *B. heptabulba* Timm, 1961).

ECOLOGICAL NOTES

The offshore area of southern California is a complex assemblage of islands, banks, ridges, basins, and troughs designated as a "continental borderland" by Shepard and Emery (1941). The narrow strip of bottom immediately adjacent to the continent forms only 6.2% of the continental borderland and is designated the mainland shelf (Emery, 1960).

Samples were collected along the inner margin of the shelf from off Santa Barbara to off San Diego, California, in 2.4 to 10.1 m. *B. californica*

occurred at 18 of 100 sampling locations. The mean depth of water was 7.6 m (range, 5.5 to 9.1) at these 18 locations. This agrees closely with the depth given by Allgen (1951:368), 3.6 to 9.1 m, for the type locality in San Diego Bay.

Bottom sediment at the type locality is described as "sandy" (Allgen, 1951:368). In the present study, sediments where *B. californica* were collected are variable, as the following values indicate: % gravel, 0.0 to 29.0 (mean, 1.7); % sand, 40.6 to 93.8 (mean, 67.1); % silt-clay, 2.7 to 59.4 (mean, 31.1). Median diameters have a somewhat more limited range of 56 to 163μ (mean, 78μ), in part due to the lack of clays in all but one sample. All sediments were well sorted, 1.15 to 1.41 (mean, 1.25).

Major elements of the macrobenthos associated with *B. californica* are summarized in Table 3. The most important of these are the polychaetes *Nephtys caecoides* and *Prionospio malmgreni*; the amphipod *Paraphoxus epitomus*; the cumacean *Diastylopsis tenuis*; and the mollusks *Tellina buttoni* and *Olivella baetica*.

METHODS

The nearshore portion of the shelf, in water depths from 2.4 to 10.1 m, was sampled from the motor launch of the research vessel "Veleo IV," using a modified 1/10 sq m Van Veen grab. The methods utilized in the shipboard handling and the laboratory analysis of these samples are described by Hartman, Barnard, and Jones (1960). The animals collected were limited by the size of the mesh, 0.495 mm, through which the sediment was screened aboard ship before preservation and sorting.

TABLE 2

INTRASPECIFIC VARIATION IN LENGTH MEASUREMENTS

♀ ♀ (52) RANGE (MEAN)	♂ ♂ (2) RANGE (MEAN)	JUV. (8) RANGE (MEAN)
L* = 2.29 — 3.35 (2.78)	2.20 — 2.72 (2.46)	1.98 — 2.44 (2.20)
a = 25.4 — 43.3 (33.2)	26.9 — 31.6 (29.3)	33.0 — 47.8 (39.5)
b = 3.1 — 4.6 (4.0)	4.1 — 4.3 (4.2)	3.5 — 4.3 (4.0)
c = 11.7 — 20.4 (16.8)	14.8 — 16.0 (15.4)	14.4 — 19.6 (15.8)
Vu = 38.3 — 47.2 (43.2)		

* Abbreviations: L = length in millimeters, a = body length/body width, b = body length/esophagus length, c = body length/tail length, Vu = vulva position as percent of body length.

TABLE 3
MAJOR MACROFAUNAL ASSOCIATES OF *Bolbella californica*

ORGANISMS BY PHYLOGENETIC GROUPS	MEAN NUMBER/0.1 M ² (RANGE)	PERCENT OCCURRENCE WITH <i>Bolbella</i>
Polychaeta:		
<i>Aricidia lopezi</i>	2.9 (0 - 16)	61
<i>Chaetozone</i> nr. <i>spinosa</i>	13.6 (0 - 45)	77
<i>Diopatra ornata</i>	1.0 (0 - .6)	61
<i>Goniada littorea</i>	14.6 (1 - 35)	100
<i>Haploscoloplos elongatus</i>	6.1 (0 - 34)	54
<i>Lumbrineris</i> spp.....	5.3 (0 - 25)	69
<i>Nephtys caecoides</i>	5.7 (0 - 13)	84
<i>Prionospio malmgreni</i>	73.5 (0 - 350)	92
<i>Prionospio pinnata</i>	4.6 (0 - 17)	84
<i>Thalenessa spinosa</i>	0.8 (0 - 2)	61
<i>Tharyx</i> spp.....	19.1 (0 - 185)	54
Amphipoda:		
<i>Parapboxus epitomus</i>	4.5 (0 - 17)	78
Cumacea:		
<i>Diastylopsis tenuis</i>	17.1 (0 - 144)	72
Mollusca:		
<i>Olivella baetica</i>	4.6 (0 - 30)	67
<i>Tellina buttoni</i>	7.9 (0 - 60)	72
Nemertea:		
unidentified species.....	9.2 (2 - 53)	100

Specific determinations of the faunal components of the samples were made by the scientists of the Allan Hancock Foundation and the Beaudette Foundation mentioned in the acknowledgments and by the author (for Nematoda and Mollusca). Sedimentary analyses were made by the geologists of the Offshore Research Project.

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